Operating manual

Index head

RTE 165

Item no. 335 6365

RTU 165

Item no. 335 4165

Dear customer,

Thank you for acquiring an OPTIMUM product. OPTIMUM metal working machines offer maximum quality, ideal technical solutions and optimum value. Ongoing development and product innovation ensure the latest technological and safety features. We want to help you in your work and be sure that you enjoy our products and get the best from our machines.

For safety reasons and to ensure problem-free working, we recommend that you read the operating manual carefully before commissioning the machine and keep it in a safe place for future reference.

Information

This operating manual provides all the necessary indications for fault-free use of this product.
Our distribution network is always at your disposal for after-sales service, spare parts and pending orders, to help you get the most out of our machines.
We always appreciate any suggestions regarding this operating manual that will help us improve the service OPTIMUM offers its customers.

The illustrations and information in the operating manual may vary from those of your product. The manufacturer constantly endeavours to improve and update its products. For this reason, visual and technical modifications may be introduced without prior notice. We hold no liability for any alterations or errors contained in this manual.

This operating manual has been drawn up by the manufacturer and forms an integral part of the equipment. The information compiled in this manual is intended for the user. The operating manual determines the intended purpose of the product and contains all the necessary information for safe and correct usage. Observing the indications set out in this manual at all times will ensure the safety of personnel and the product and a long service life. To aid comprehension, this operating manual is divided into various sections covering the most important issues. The table of contents gives a quick overview of the individual issues. Important passages are marked in bold type and are preceded by the following symbols:

If you have any further questions, please contact your local dealer.

Explanations:

NOTE
Refers to situations that could cause injury to persons, damage to the product and/or the surroundings or financial loss - or refers to an easier or better way of carrying out operations.

ATTENTION:
Do not smoke! Also avoid fire and naked flames.

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1. Scope of application

The index heads RTE 165 and RTU 165 are used as accessories for milling and drilling machines and for other metal working machines.
The index head is required for manufacturing workpieces on which you have to do milling or drilling work with certain divisions (gearwheels, spline shafts, squares, etc.).
There are two ways of dividing:

- Fast dividing with notch plates (direct dividing).
- Dividing by degrees and minutes with the help of the handwheel via the worm gear (indirect dividing).

2. Technical data and dimensions

	RTE 165	**RTU 165**
Head diameter	165 mm	165 mm
Overall height	200 mm	221 mm
Width	260 mm	250 mm
Length	218 mm	235 mm
Height of centres	130 mm	130 mm
Diameter of fixing plate (optional)	203 mm	203 mm
Capacity	36 mm	36 mm
Weight	32.5 kg	48 kg
Master index plate	24 divisions (= 15°)	
Indirect dividing plates	2, 3, 4, 6, 8 and 12 divisions	
Indexing accuracy of direct indexing mechanism, maximum cumulative spacing error	45“	
Run out of clamping surface of 3-jaw chuck [mm]	0,02	
Thrust accuracy of clamping surface of 3-jaw chuck [mm]	0,015	
Parallelism of base to clamping surface of 3-jaw chuck [mm]	0,02	
Run out of center of 3-jaw chuck [mm]	0,03	
Concentricity precision of the taper bore [mm]	0,02	
Possibility of fixing	vertical and horizontal fixing	
Clamping table	with 360° dial	
Quick-action holding fixture		

3. Extent of supply and accessories

3.1 Extent of supply

When the index head is delivered, check immediately that the drill has not been damaged during shipping and that all components are included. Remove all parts from the cardboard box and check them against the following list:

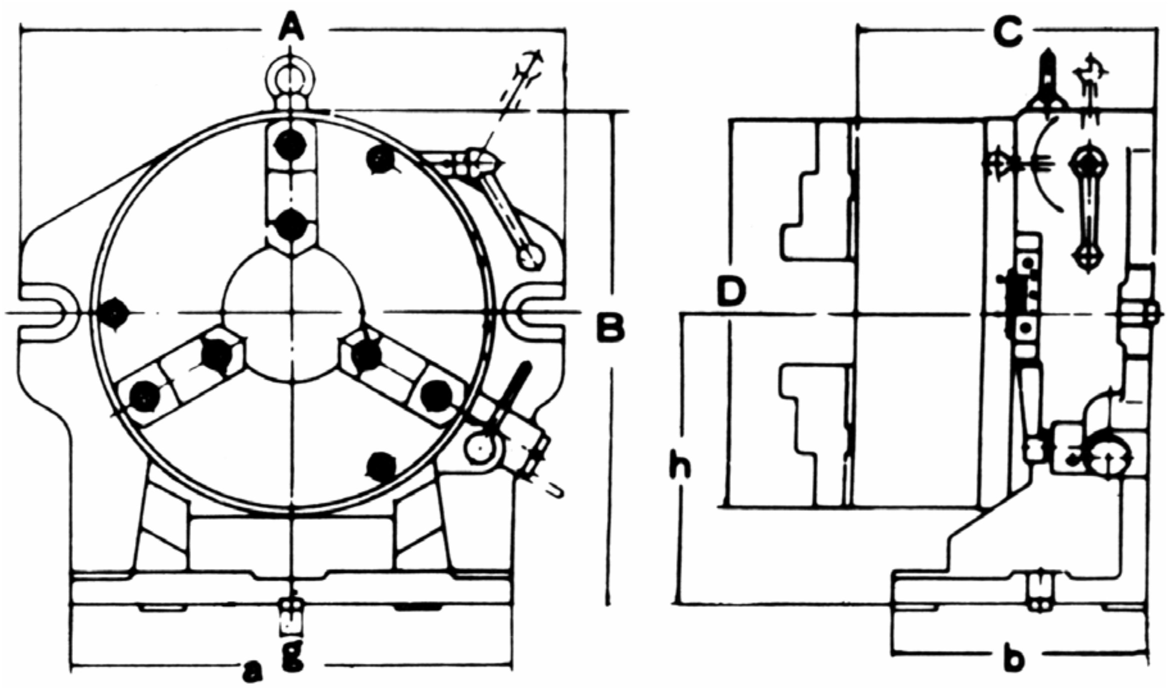
- **Index head**
- **3-jaw chuck (mounted)**
- **Fixing plate**
- **Master index plate (24 division, mounted)**
- **6 notch plates**
- **Handles for the handwheel (only RTU 165)**

3.2 Extras

We recommend that you use only high-quality original OPTIMUM accessories. Only original accessories can guarantee optimum working results.

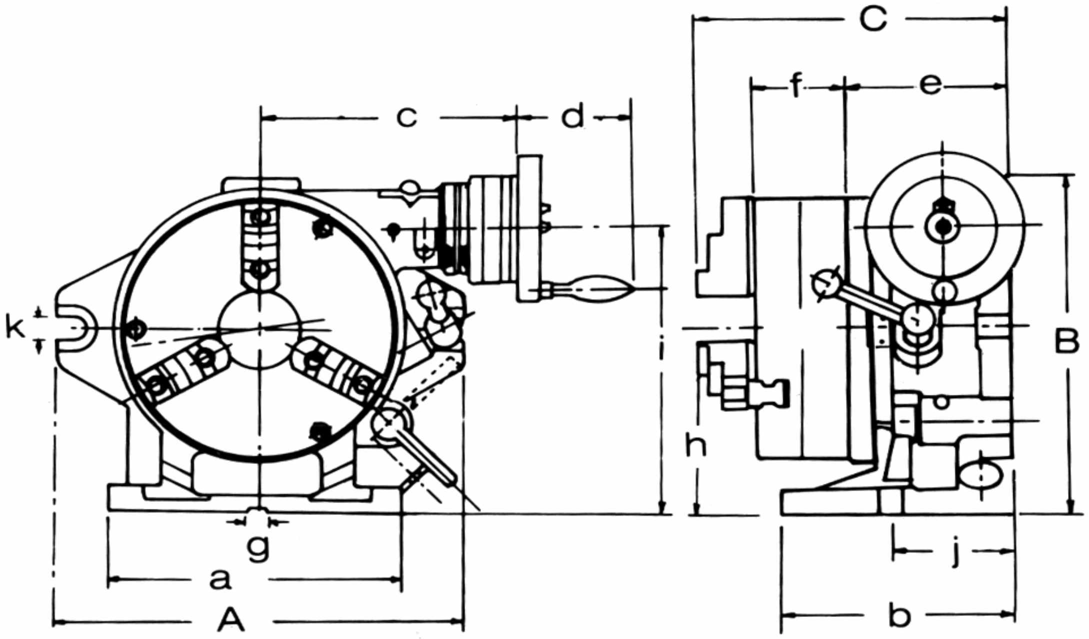
Name	**Item no.**
Fixing plate RTE / RTU	335 4166
Height-adjustable tailstock RST 2 for RTE / RTU	335 6157
Indirect dividing attachment IT 200, only for RTU 165	335 6205

3.3 Dimensions RTE 165



A	B	C	D	A	B	h
260	218	156.2	167	220	130	130

3.4 Dimensions RTU 165



A	B	C	A	B	C	D	e	F	g	h	I	j	k
250	235	221	220	150	184	82	112	66	16	130	186	80	18

4. Cleaning the index head

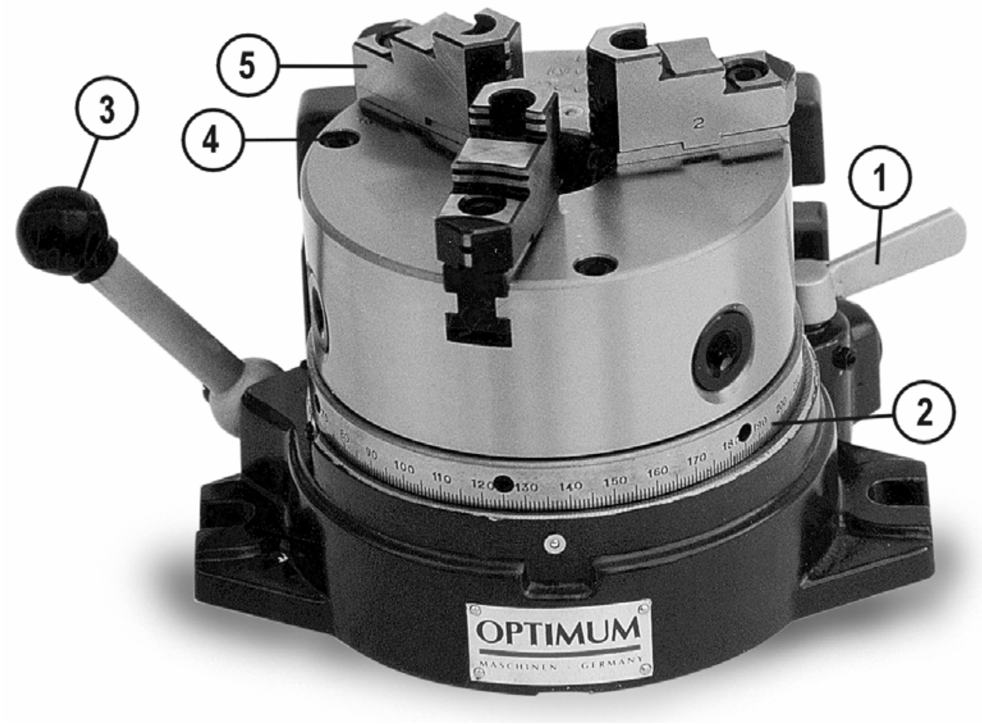
For protection against corrosion, all bright parts are covered ex factory with protective grease or oil. Before first use, clean the parts with a suitable nonpolluting cleaning agent. For cleaning, do not use any solvent, thinner or cleaning agent which might corrode the varnish of the dividing attachment. Use the data and instructions of the cleaning agent manufacturer. Make sure the area is well ventilated during the cleaning process in order to prevent health hazards resulting from noxious fumes.

After every use of the index head, all bright machine parts must be lightly lubricated! Use a non-corrosive lubricating oil.

ATTENTION!
Many cleaning agents are combustible and highly inflammable. You must not smoke when handling cleaning agents. Fire and naked flames are forbidden!

Note:
Oil, grease and cleaning agents are pollutants and must not be disposed of through the drains or in normal refuse. Dispose of those agents in accordance with current legal requirements on the environment. Cleaning rags impregnated with oil, grease and cleaning agents are easily inflammable. Collect cleaning rags or cleaning wool in a suitable closed vessel and dispose of them in an environmentally sound way - do not put them with normal refuse!

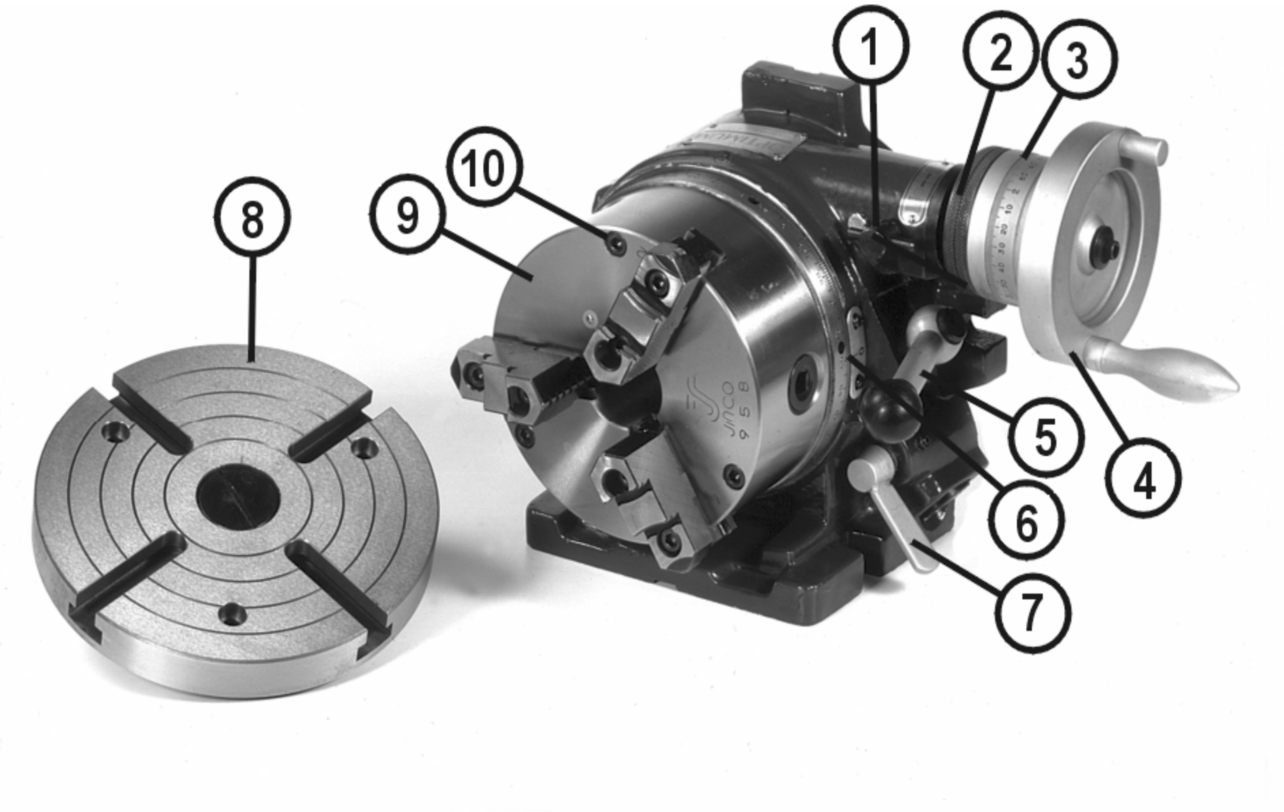
5. Control elements



5.1 Control elements RTE 165

1. Notch lever
2. 360° dial on the index head
3. Quick-action clamping lever
4. Fastening screws (3 pcs.)
5. 3-jaw chuck

C Control elements RTU 165



1. Locking screw for indicator ring
2. Indicator ring
3. Dial on the handwheel
4. Handwheel
5. Quick-action clamping lever
6. 360° dial on the index head
7. Notch lever
8. Fixing plate
9. 3-jaw chuck
10. Fastening screws (3 pcs.)

The handle for the handwheel is contained in the enclosed cardboard box together with the index plates and has to be mounted!

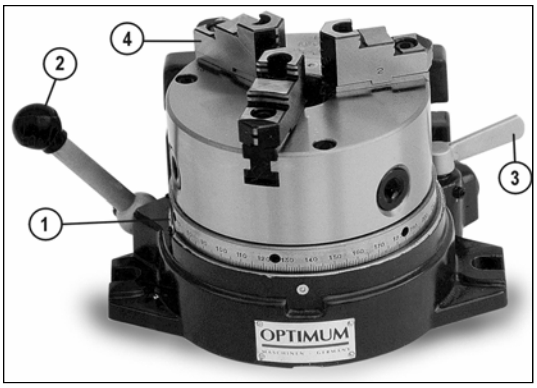
6. Using the index head

You can immobilise and release the index head with the help of the quick-action clamping lever.
To obtain exact working results - and protect the dividing attachment – you should clamp the table for each metal removing operation (= after each shifting).

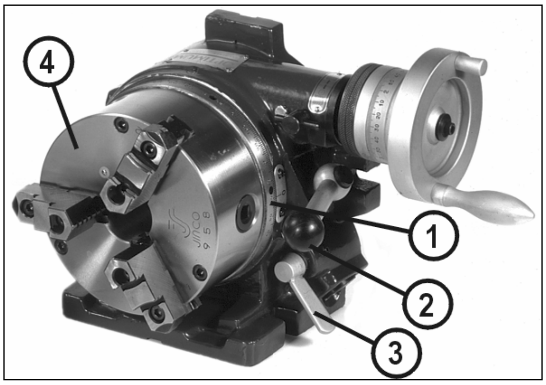
6.1 Fast dividing with notch plates (direct dividing)

Using the notch plates it is possible to produce divisions safely, exactly and rapidly.
ATTENTION: The worm of the index head RTU 165 must be disengaged (turning the handwheel has no effect) to prevent it from being damaged!

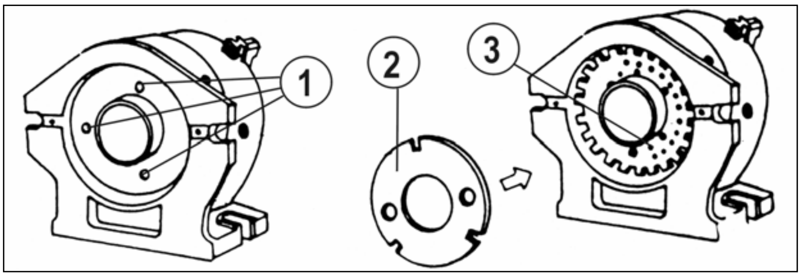
The mounted 24-division master index plate is hardened and ground. This ensures high precision and a long service life. A shift from one notch on the 24-division master index plate to the next corresponds to a division of 15°. You can double-check the degree shift on the 360° index head dial (1).
To shift the index plate, you must release the quick-action holding fixture with the clamping lever (2). Then disengage the indexing bolt of the index plate by shifting the notch lever (3) (hold notch lever; reset the spring). Now you can shift the index head using the 3-jaw chuck (4). After releasing the notch lever, the indexing bolt engages automatically in the next notch. Immobilise the index head again.



Apart from the 24-way division, the 24-division master index plate, can of course be used to produce divisions of 2, 3, 4, 6, 8 and 12. This is recommended if you only have to produce a small number of workpieces.
When performing these divisions, bear in mind that you have to shift various notches in order to obtain the required division. Also verify the adjustments on the dial.



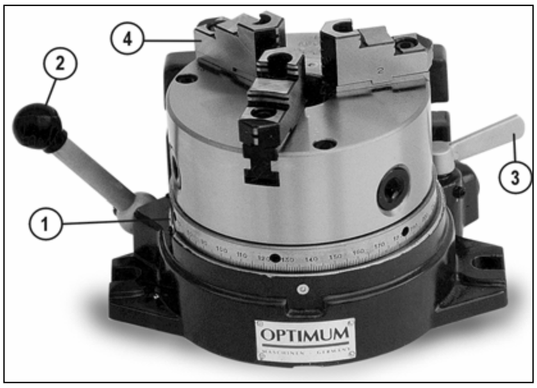
To produce various workpieces with the same division (2, 3, 4, 6, 8 or 12) rapidly and safely, we recommend that you use the corresponding notch plate. To install a notch plate, remove the covering flange on the bearing surface opposite the 3-jaw chuck by unscrewing the 3 Allen screws (1). Now you can put the required notch plate (2) over the 24-division master index plate. You will find a positioning pin on one side of each notch plate. Make sure that the positioning pin engages in the intended bore holes of the master index plate (3). Fit the covering flange again. The indexing bolt will now only engage in the notches of the notch plate.



6.2 Dividing by degrees

6.2.1 Index head RTE 165

You can shift the index plate by a specific number of degrees using the 360° dial (1) on the index head.
First, release the quick-action holding fixture with the clamping lever (2). Then, disengage the indexing bolt of the index plate by shifting the notch lever (3) (hold notch lever; reset the spring). You can now shift the index head using the 3-jaw chuck (4) the required number of degrees. Once you have reached the desired regulation, clamp the index head. You can also release the notch lever again.

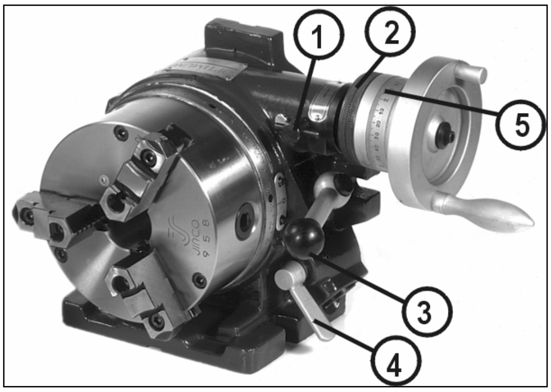


6.2.2 Index head RTU 165

Shifting may be carried out in the same way as with the RTE 165, i.e. using the 360° dial. Proceed as with the RTE 165 index head.
ATTENTION:The worm must be disengaged (turning the handwheel has no effect) to prevent it from being damaged!

6.3 Indirect dividing (by degrees)

For indirect dividing, shifting is not carried out on the index head, but "indirectly“ with a handwheel, via a worm gear. This method is considerably more precise.
To engage the worm gear, first loosen the locking screw (1) at the worm gear. Then turn the indicator ring (2) approximately one quarter turn clockwise. The worm should perceptibly engage, as only in this case exact shifting without slack is ensured. Immobilise the worm against accidental loosening again by fastening the locking screw (1).
To make divisions using the worm gear, release the quick-action holding fixture (3) - and disengage the indexing bolt (4).
By turning the handwheel you can now shift the plate the desired number of degrees. Once the desired shifting position has been reached, immobilise the index head again using the quick-action holding fixture (3)!



The transmission ratio of the worm gear is 1:90. This gives a shifting displacement of the index head of 4° for each full circle of the handwheel of the worm wheel. The dial on the handwheel (5) has a scale from 0 to 4 degrees with a graduation of 1 minute per mark. Using the additional vernier you can achieve a setting accuracy of up to 10 seconds.

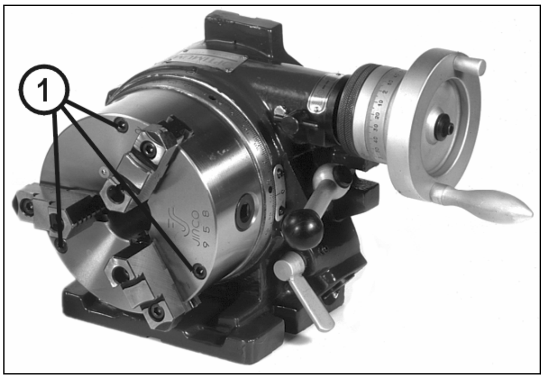
EXAMPLE 1: Required division D= 18; handwheel 1 turn = 4°
Answer: 360° : 18 = 20°; 4° * 5 = 20°
The handwheel has to be turned 20° per division (= exactly 5 turns)

EXAMPLE 2: Required division D= 48; handwheel 1 turn = 4°
Answer: 360° : 50 = 7,5° = 7° 30´
The handwheel has to be turned 7° 30´ per division (= 1 complete turn + 3° + 30´)

7. Detaching the 3-jaw chuck

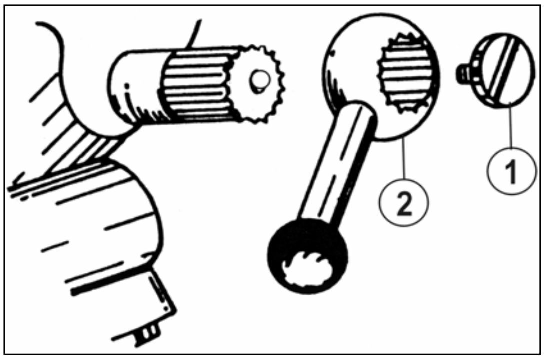
To detach the 3-jaw chuck, remove the 3 screws (1). The 3-jaw chuck can now be taken off from the front. You can then mount the fixing plate, for example.

Always check the concentricity precision of the clamping devices and the workpieces!



8. Adjustments

If the clamping lever for the quick-action clamping interferes with machining operation, it can very easily be transferred.
Loosen the safety screw (1) directly on the lever holding fixture. You can then detach the lever (2) from the front and transfer it. Finally, fasten the safety screw again.



9. Extras

We recommend the use of original OPTIMUM accessories:

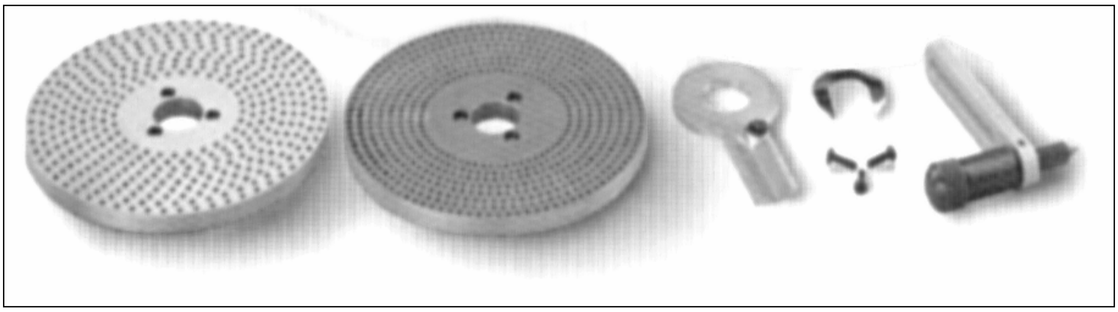
9.1 Tailstock

Height-adjustable tailstock RST 2 (approx. 103 - 166mm), item no. 335 6157

9.2 Indirect dividing attachment

The indirect dividing attachment may only be attached to the RTU 165 index head!

Indirect dividing attachment IT 200, item no. 335 6205
Including: 2 index plates, indexing plunger, dividing shears and mounting parts



The 2 index plates (A and B) are equipped with pitch circles on either side. Using the index plates you can produce divisions of up to 100.

Pitch circles on the index plates:
Index plate A: 26, 28, 30, 32, 34, 37, 38, 39, 41, 43, 44, 46, 47, 49, 51, 53, 57 and 59
Index plate B: 61, 63, 67, 69, 71, 73, 77, 79, 81, 83, 87, 89, 91, 97, 99

"Indirect divisions“ are achieved using the worm gear (transmission ratio 1:90). With this method it is still possible to produce certain divisions with the handwheel – such as the adjustment by degrees (see also 6.2.2).
Thus, the required division D = 18 in Example 1 on Page 9 can also be calculated using the worm gear (1:90): 90 : 18 = 5 (= 5 full circles on the handwheel).

Exact, irregular division, however, cannot be achieved by graduations - or only with certain difficulties and you will need the "indirect dividing attachment“. The indirect dividing attachment consists of indexing disks, dividing shears and an indexing plunger. Using the different pitch circles on the indexing disks, you can produce nearly every division.

Calculating the pitch circle and the pitch (using example division D=48):
First, you will need to know the available pitch circles of the index plates:
Index plate A: 26, 28, 30, 32, 34, 37, 38, 39, 41, 43, 44, 46, 47, 49, 51, 53, 57 and 59
Index plate B: 61, 63, 67, 69, 71, 73, 77, 79, 81, 83, 87, 89, 91, 97, 99

Using the formula $N = \frac{i}{D}$ you can calculate the pitch circle.
(N=Number of turns, i=Transmission ratio of worm drive, D=Division)

$N = \frac{90}{48} = 1\ \frac{42}{48} = 1\ \frac{7}{8}\ \frac{(7 \times 4)}{(8 \times 4)} = 1\ \frac{28}{32}$ = 1 turn + 28 bore holes on the 32-hole pitch circle

Explanation: Take the denominator of the fraction (in this case 8) and choose from the pitch circles of the index plates the one that is an integral multiple of that number (in this case: 8 * 4 = 32). The numerator should be multiplied by the same number (in this case 4) to get the pitch (in this case 28), which has to be turned with the crank on the calculated pitch circle.

To spare you complicated calculations, we have compiled a table giving the necessary information (indexing disks, pitch circle and pitch) for all divisions from 2 to 100.
Please see the table on the next page.
This table is meant to be used only for this dividing attachment with the corresponding index plates! The most common divisions (from 2 to 24) may be produced by "direct dividing" using the master index plate – for some divisions, more than one solution is given.

9.2.1 Pitch circle table for RTE 165 / RTU 165 with worm transmission ratio 1:90

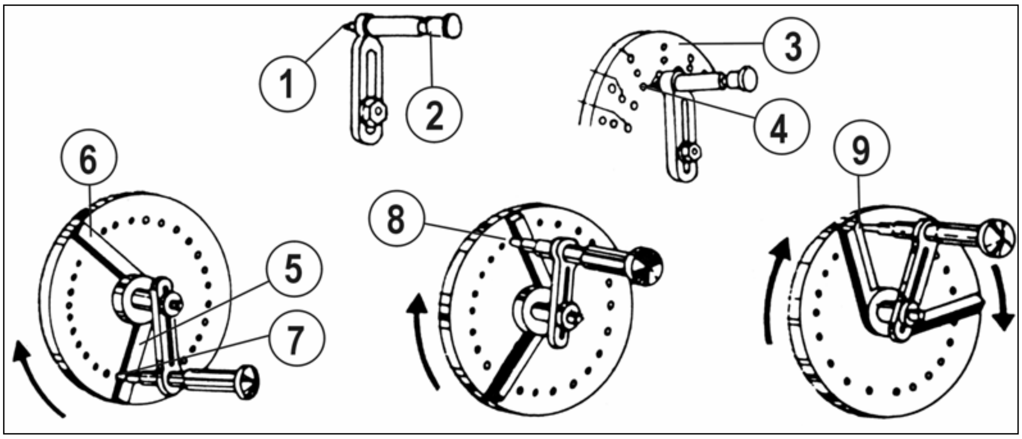
D	DD	ID	N	D	ID	N	D	ID	N
2	**		45	35	A -28	2 16/28	66	A -44	1 16/44
3	**		30		B -63	2 36/63		B -99	1 36/99
4	**		22.5	36		2.5	67	B -67	1 23/67
5			18		A -26	2 13/26	68	A -34	1 11/34
6	**		30		A -28	2 14/28	69	A -46	1 14/46
7		A –28	12 24/28	37	A -37	2 16/37		B -69	1 21/69
		B –77	12 66/77	38	A -38	2 14/38	70	A -28	1 8/28
8	**		11.25	39	A -26	2 8/26		B -63	1 18/63
9			10		B -91	2 28/91	71	B -71	1 19/71
10			9	40	A -28	2 7/28	72	A -32	1 8/32
11		A –44	8 8/44		A -44	2 11/44		A -44	1 11/44
		B –77	8 14/77	41	A -41	2 8/41	73	B -73	1 17/73
12	**		7.5	42	A -28	2 4/28	74	A -37	1 8/37
13		A –26	6 24/26		B -63	2 9/63	75	A -30	1 6/30
		B –91	6 84/91	43	A -43	2 4/43	76	A -38	1 7/38
14		A –28	6 12/28	44	A -44	2 2/44	77	B -77	1 13/77
		B –77	6 13/77	45		2	78	A -39	1 6/39
15			6	46	A -46	1 44/46		B -91	1 14/91
16		A –32	5 20/32		B -69	1 66/69	79	B -79	1 11/79
17		A –34	5 10/34	47	A -47	1 43/47	80	A -32	1 4/32
18			5	48	A -32	1 28/32	81	B -63	1 7/63
19		A –38	4 28/38	49	A -49	1 41/49		B -81	1 9/81
20			4.5	50	A -30	1 24/30	82	A -41	1 4/41
		A –26	4 13/26	51	A -34	1 26/34	83	B -83	1 7/83
		A –28	4 14/28	52	A -26	1 19/26	84	A -28	1 2/28
21		A –28	4 8/28	53	A -53	1 37/53	85	A -34	1 2/34
		B –77	4 22/77	54	A -30	1 20/30	86	A -43	1 2/43
22		A –44	4 4/44		B -63	1 42/63	87	B -87	1 3/87
		B –77	4 7/77	55	A -44	1 28/44	88	A -44	1 1/44
23		A –46	3 42/46		B -77	1 49/77	89	B -89	1 1/89
		B –69	3 63/69	56	A -28	1 17/28	90		1
24	**		3.75	57	A -38	1 22/38	91	B -91	90/91
25		A –30	3 18/30	58	B -87	1 48/87	92	A -46	45/46
26		A –26	3 12/26	59	A -59	1 31/59	93	B -93	90/93
		B –91	3 42/91	60		1.5	94	A -47	45/47
27		A –30	3 10/30		A -33	1 16/32	95	A -38	36/38
		B –63	3 21/63		A -34	1 17/34	96	A -32	30/32
28		A –28	3 6/28	61	B -61	1 29/61	97	B -97	90/97
29		B –87	3 9/87	62	B -93	1 42/93	98	A -49	45/49
30			3	63	A -49	1 21/49	99	A -44	40/44
31		B –93	2 84/93		B -77	1 33/77		B -99	90/99
32		A –32	2 26/32	64	A -32	1 13/32	100	A -30	27/30
33		B –99	2 72/99	65	A -26	1 10/26			
34		A –34	2 22/34	65	B -91	1 35/91			

D = Number of divisions
DD = Direct division (2 – 24)
ID = Indexing disk (A / B) and pitch circle
N = Number of full circles and/or pitch / on the pitch circle

**** Feasible with master index plate or notch plate**

9.2.2 Mounting the indexing disks and performing divisions

After calculating the pitch circle and determining the indexing disk, you have to mount the corresponding indexing disk with the dividing shears and the indexing bolt on the worm drive of the dividing attachment. First detach the handwheel with the graduated collar by loosening the screw on the handwheel. Take off the handwheel with the graduated collar towards the front. Then, push the indexing disk onto the shaft and fix it with the 3 screws. Next, mount the dividing shears and fix them with the spring. Finally, push the oblong hole on the indexing plunger onto the shaft, fitting the straight sides of the hole onto the straight sides of the shaft. Make sure that the index pin (1) locks into a bore hole (4) in the correct pitch circle of the indexing disk (3) before you screw the fastening screw of the indexing plunger into the worm shaft and tighten it.



Position the left shear leg (5) directly at the engaged positioning pin (7) of the crank. Then, count the calculated bore holes on the corresponding pitch circle after the positioning pin and position the right shear leg directly behind the last bore hole.

Thus, the dividing shears always encompasses 1 hole more than the number given (For a value of 28 holes on the 32-division pitch circle, the shears encompasses 29 holes)! The encompassed area is called a "sector".

Make sure that you only shift in one direction (in this case, clockwise)!

If you have completed your operation (e.g. boring operation), pass on to the next division on the indexing disk by pulling the crank outwards. Then, first make the "full" circles (if indicated) and then lock the positioning pin of the crank in the last bore hole of the sector (8) encompassed by the dividing shears. Push the dividing shears by setting the left shear leg next to the engaged positioning pin (9) again.
Proceed with the next pending operation.

Repeat this operation until you have finished all divisions.

10. Maintenance

To ensure the precision and correct functioning of the index head, it is essential that you treat it with care, keep it clean and grease and lubricate it regularly. Only good care will ensure constant working quality of all components.

After every use of the index head, all bright machine parts must be lightly lubricated! Use a non-corrosive lubricating oil.

11. Warranty

The warranty period is 6 months from the delivery date (the warranty document is the invoice document).

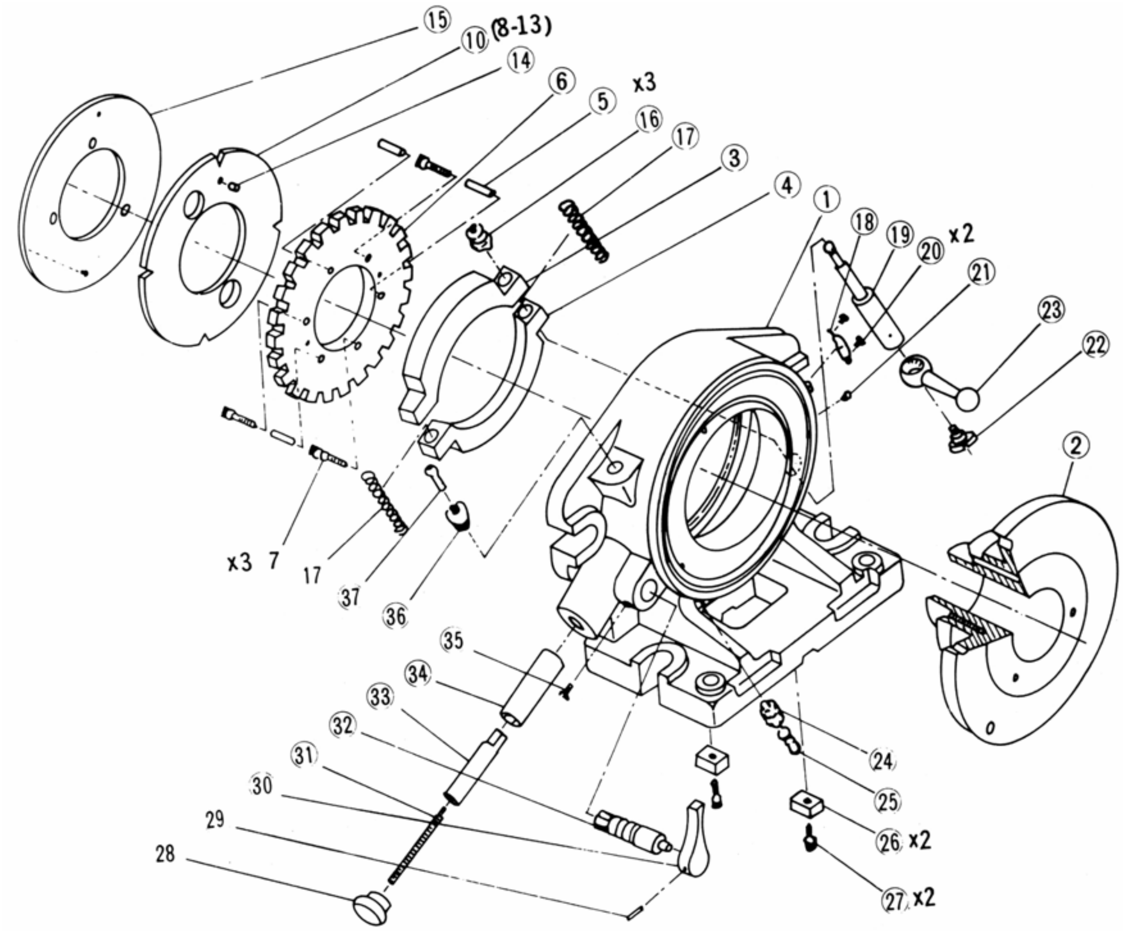
No responsibility will be taken from damage resulting from the following causes:
Inappropriate or improper usage, incorrect installation or commissioning by the orderer or third parties as well as natural wear, incorrect or negligent treatment, inappropriate operating material, replacement material, deficient construction work, inappropriate foundation soil, chemical, electrochemical or electrical influences, unless they can be attributed to the supplier.

12. Troubleshooting

Problem	Possible cause	Solution
Impossible to shift index head	Quick-action holding fixture still locked Notch lever still engaged	Release quick-action holding fixture Disengage notch lever
Worm transmission slack	Worm not completely swivelled in	Swivel worm with indicator ring completely

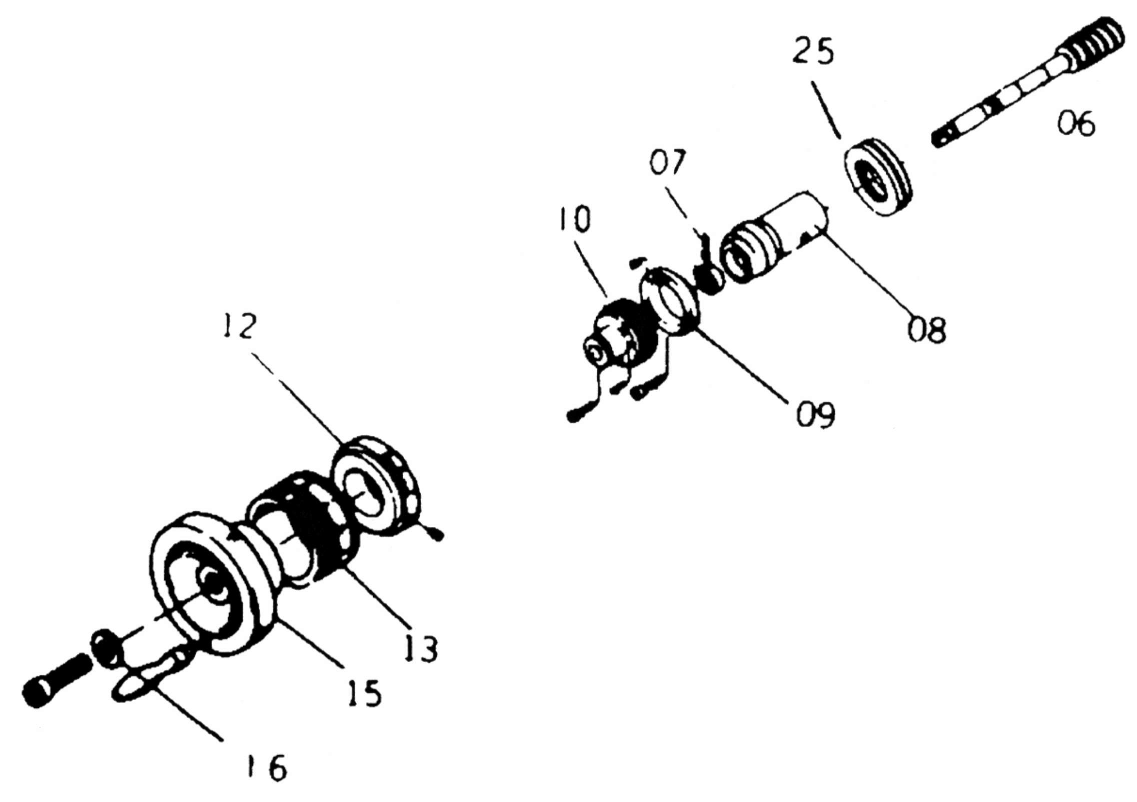
13. Exploded views

A RTE 165



Pos.	Name	Artikelnr.	Qty.
1	Base	0335636501	1
2	Holding fixture with dial	0335636502	1
3	Upper clamping piece	0335636503	1
4	Lower clamping piece	0335636504	1
5	Positioning pin	0335636505	3
6	Master index plate	0335636506	1
7	Screw	0335636507	3
8	Notch plate T=2	0335636508	1
9	Notch plate T=3	0335636509	1
10	Notch plate T=4	0335636510	1
11	Notch plate T=6	0335636511	1
12	Notch plate T=8	0335636512	1
13	Notch plate T=12	0335636513	1
14	Positioning pin for notch plate	0335636514	1
15	Covering flange	0335636515	1
16	Holding fixture	0335636516	1
17	Spring	0335636517	2
18	"0 mark“ label	0335636518	1
19	Stud for quick-action holding fixture	0335636519	1
20	Rivet for label	0335636520	2
21	Screw	0335636521	1
22	Fastening screw	0335636522	1
23	Quick-action clamping lever	0335636523	1
24	Transition piece	0335636524	1
25	Lock	0335636525	1
26	Tenon block	0335636526	2
27	Screw for tenon block	0335636527	2
28	Button	0335636528	1
29	Locking pin	0335636529	1
30	Clamping lever	0335636530	1
31	Spring	0335636531	1
32	Stud	0335636532	1
33	Notch	0335636533	1
34	Bush	0335636534	1
35	Screw	0335636535	1
36	Holding fixture	0335636536	1
37	Dowel pin	0335636537	1

B RTU 165 (worm)



Pos.	Name	Qty.	Article no.
05	Worm wheel (w/o illustration)	1	0335416505
06	Worm	1	0335416506
07	Disengaging piece	1	0335416507
08	Eccentric bush	1	0335416508
09	Ring	1	0335416509
10	Dial support	1	0335416510
11	Locking screw (w/o illustration)	1	0335416511
12	Indicator ring	1	0335416512
13	Graduated collar	1	0335416513
15	Handwheel	1	0335416515
16	Screw and washer	1	0335416516
25	Thrust bearing	1	0335416525

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